The cartoon on the cover of this compact hardback shows a magician pulling out of his hat not a rabbit but the five Platonic solids. The book is, indeed, beautifully illustrated throughout, consisting largely of short chapters separated by fascinating 'diversions', many of which are important applications of geometry in science and everyday life. Amongst the topics covered are Pythagoras' theorem, the golden ratio, Descartes' use of coordinates, Ceva's theorem, Fermat's challenge to Torricelli, the parallel postulate, non-Euclidean geometry and the 'new science' of fractals. There is even a discussion of how the Mathematical Association in 1893 was formed as a response to the sterility of geometry teaching in many schools, which treated Euclid's *Elements* in a quasi-religious sense as something to be quoted from chapter and verse.

This book is an admirable counterweight to this attitude. Indeed, it is full of challenges for the reader, and the appendices provide solutions to problems and an excellent bibliography for further reading. It would make an ideal addition both to readers' bookshelves and for every school library.

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Thinking probabilistically by Ariel Amir, pp. 242, £39.99 (paper), ISBN 978-1-10878-998-1, Cambridge University Press (2021) (e-copy reviewed)

The title and one or two of the initial examples suggest that this book may be addressed to a popular readership, but do not be misled. It is a book of advanced undergraduate statistical mechanics, in fact the course book for an Applied Mathematics course at Harvard (APMAT 203, *Introduction to disordered systems and stochastic processes*). The first sentence of the Introduction suggests the scope: "to familiarize you with a broad range of examples where randomness plays a key role, develop an intuition for it, and *get to the level where you may read a recent research paper on the subject* and be able to understand the terminology, the context, and the tools used" (my italics). Prerequisites include calculus up to, for example, standard techniques of solving PDEs, standard results in linear algebra such as the unitary diagonalisation of Hermitian matrices, and Lagrange multipliers. However, the author also stresses in the introduction that the contents will not be mathematically rigorous.

The introductory chapter illustrates some of the counter-intuitive surprises that students must expect to encounter in any area of probability. Examples include a geometric model for bus departure times; this is elementary given what is to follow, but it is picked up later in discussion of eigenvalue distributions in random matrix theory.

The basic approach is a fast progress though the actual mathematics, though with asides in the form of clarifications and with references to appendices for some techniques, and diagrams that interpret the results. For example, Chapter 2 concerns random walks in 1D and then in arbitrary dimension, together with Markov chains. Amir derives the 3D diffusion equation on the basis of symmetries, but turns aside helpfully to answer the question "To which order should we [Taylor] expand?", then Fourier-transforms the equation and finally shows a scatter plot that displays sinusoidal density. Intuitive comments are added on the way. The quantity of help diminishes as the book progresses, and later chapters are increasingly theoretical, particularly those on the generalised central limit theorem (sums of random variables with large tails), and random matrix theory. Other chapters consider the Langevin and Fokker-Planck equations and applications, including Black-Scholes; escape over a barrier; noise;

anomalous diffusion; and percolation theory. Thus much of the physics involved comes under the general heading of diffusion and includes most of the statistical mechanics in the current Cambridge Parts II and III in mathematics and natural sciences/physics.

There are between five and fifteen extended problems at the end of each chapter (but no solutions). It is part of the author's philosophy that these problems do not admit a routine, unthinking approach, nor, for the most part, are they theoretical. The intention is to reflect the sort of issues that attend problem-solving in real life. I cannot judge how effective such an individual approach would be for learners, but the fact that the book has been developed as a result of teaching the course suggests that it can be made to work.

The title of the book implies an intention to create a mind-set rather than to provide particular examples, but there is also quite a bit of theory. Advanced undergraduates studying statistical mechanics will find the book useful, and instructors of appropriate courses will want to consider recommending it, at least as a supplementary text. My thanks to Anson Cheung for advice with this review.

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Fundamentals of graph theory by Allan Bickle, pp. 336, $85, ISBN 978-1-4704-5342-8, American Mathematical Society (2020)

Any instructor teaching an undergraduate or graduate course in graph theory should seriously consider this excellent book as a possible text. It is clearly and enticingly written in an accessible modern style, adroitly mixes theory and applications, contains both numerous examples (some fairly elaborate) and lots of exercises covering a broad span of difficulty, and covers not only the topics discussed in a standard graph theory course but also some less standard material (including, on several occasions, quite new results in the subject, proved within the last five or six years).

There is probably enough material here for a two-semester course, but the book can be easily adapted to courses of one semester's duration. There are ten chapters, the last one of which is an Appendix. The book begins with the basic definitions and facts regarding graphs, along with many examples. Subsequent chapters cover, in order: trees and connectivity, Eulerian graphs, vertex coloring, planar graphs, Hamiltonian graphs, and matchings. The last two non-Appendix chapters cover generalized graph coverings and decompositions (including sections on Ramsey numbers and Nordhaus-Gaddum theorems). This is material not generally covered in textbooks at this level and, I imagine, would likely be skipped by most professors teaching a one-semester undergraduate course.

A detailed and helpful chart (covering two pages) not only shows the interdependence of the various text sections but also gives the author's opinions as to the importance of each section, and suggestions for the amount of time to be spent on each each section. The chart even indicates, when specifying section interdependence, which sections are essentially dependent and which are inessentially dependent.

The author writes succinctly (this is a slim book), yet clearly. Concepts are generally introduced by motivating examples followed by precise definitions and theorems. Prerequisites for reading the book are relatively modest. In addition to the standard 'mathematical maturity', some minimal knowledge of linear algebra (matrix